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REPORT

# Enhanced UK Teletext moves towards still pictures

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**Summary**

*The UK teletext specification includes several provisions for future enhancement of the system while retaining its basic ruggedness and efficiency. By means of an example of a possible specification of an enhanced UK teletext system, this Report draws attention to the immediate benefits that could be provided. It indicates how later extensions up to and including the broadcasting of high-quality still pictures can be achieved.*

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## 1. Introduction

The UK teletext system has been a full public service for almost four years, and the specification of the system has remained unaltered. It is expected that by the end of 1980 there will be more than 100 000 teletext receivers in use. There is no doubt that the system rests on a firm technical foundation and the deliberate attempt made to stretch technology at the time the specification was formulated means that the system is giving the highest possible information transfer rate consistent with ruggedness and freedom from errors.

In the UK the only significant criticism of teletext has been that the access time is slow. Typically, with two data lines per field, a broadcast magazine will contain a major cycle of about 90 pages repeating about every 20 seconds, and consequently the average waiting time compares unfavourably with that of an interactive viewdata service using the telephone line, such as Prestel.

In Europe the UK teletext system as it stands is not appropriate to the character requirements of many of the languages used. Moreover, there is a desire to be able to mix languages within a single teletext page. A survey of the requirements of the members of the European Broadcasting Union[1] shows that a common-core alphabet of about 200 characters is needed for languages using the Latin alphabet. A requirement to underline text has also been identified.

It is accepted that UK teletext is the beginning of a line of development leading to an enhanced teletext system whose capability is limited only by the display device itself, and capable of producing a sequence of still pictures with a full range of colour, and definition superior to that of the current broadcast television systems. Such a system would, of course, be capable of handling material from systems such as Antiope and Telidon should this prove necessary. An enhanced teletext system should also provide for particular types of auxiliary data such as programme labelling, as well as allowing arbitrary data to be sent as part of a teletext magazine or on totally independent channels within the teletext format.

By reference to a particular proposal, which is annexed, this paper indicates how the UK teletext system can be extended to meet all these requirements, including improved access, while retaining full compatibility with, and the ruggedness of, the existing system. The techniques are described in terms of the 625/50 television system, the adaptation to 525/60 systems has been discussed elsewhere.[2]

## 2. Improved access

The UK teletext system already includes ample provision for uniquely addressing individual pages. Within each of eight independent magazines, selected by a single digit, 100 pages can be selected by a further two-digit page number and up to 3200 versions of each page can be selected by a further four-digit subcode (formerly known as 'Time-Code'). So even using the existing keyboards and decoders over 2½ million different pages can be individually accessed. The addition of a 'don't-care' key (see A.2.1.4) allows groups or sequences of pages to be accessed.

Already teletext decoder chip sets are available in the UK which support more than one page store. This means that while a page is being viewed several other pages can be captured and stored ready for instant access. This poses two questions; which other pages should the decoder capture and how does it know when it's caught them?

### 2.1. Linked Pages

One way of deciding on the choice of pages is to give the viewer the facility to preprogramme a popular selection into the decoder, preferably with non-volatile storage associated with each television channel. Then, when the set is switch on and a channel is selected, the chosen set of pages is captured at the earliest opportunity, ready for viewing. A sequence of pages could be stored so that while any one page is being read, the next one or two are being captured. This approach can be coupled with a quick-select facility so that pre-programmed pages, which normally require a three- or seven-digit number to select them, can be accessed using a single keystroke as in a repertory telephone dialler.

This approach, however, depends on the teletext magazine of a particular television channel

having a regular structure. From time to time in the UK there is pressure to, for example, always put the Newsflash on page 250 and the initial index on page 100. Such a practice could, however, place an increasingly severe constraint on the editor and sacrifice one of the great strengths of teletext, which is its flexible structure that can be changed instantly to accommodate both the expected and the unexpected. A much more adaptable technique invokes linked pages using the page service row (Annex B) to provide details of up to six pages related to any particular page, and the television service data-line (Annex C) to indicate the initial teletext page of that television channel. This allows the teletext editor to structure the pages into decision trees in such a way that, while any page is being read, up to six related pages are being captured. When a choice is made the new page is immediately available by an abbreviated code of one or two keystrokes. Fig. 1 shows a Ceefax news headlines page with information added to show how linked pages could be indicated. Fig. 2 shows how the operation #4 leads to a new page and a further selection. There is a variety of ways in which the structure could be organised, for example, a long string of pages could include provision for jumps to the next, the previous, the first or the last page of the string.

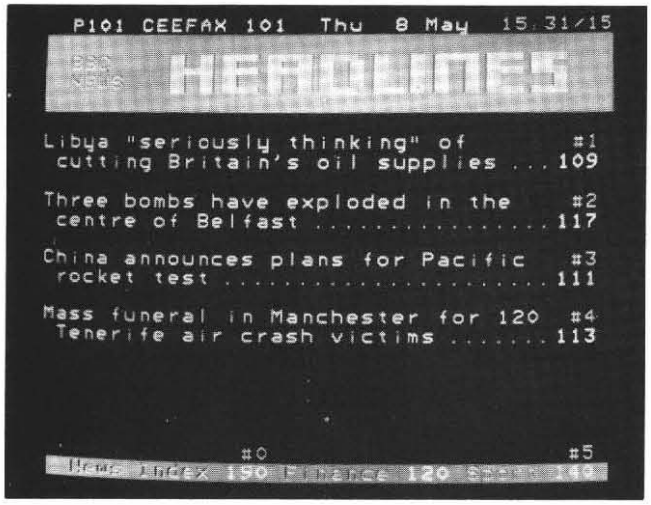



*Fig. 1 - A Ceefax page with linking information added*

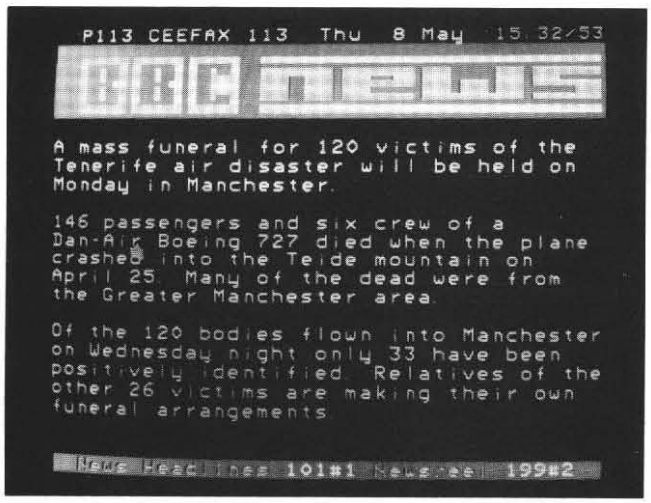



*Fig. 2 - A Ceefax page linked to that in Fig. 1*

### 2.2. Page Check Word

Particularly when a multiple page store is used, a definite indication is required to signify that any particular page has been correctly and completely received. This operation should not require human intervention and judgement, as future uses of teletext systems may involve the dumping of several hundred pages at a time into a mass store. In Annex B there is a proposal that an optional service row associated with each page should include a cyclic redundancy check (CRC) word of the entire page content, including presumed characters occupying any rows that were not transmitted. A 16-bit check word would identify 99.998% of all possible error patterns, and an even higher proportion of all likely error patterns. In an automatic page capture routine this test would allow a correct page to be protected in the store and the routine could continue with the next task. When a page is being viewed directly the viewer could be given an indication whether the page had a check word and whether the check was successful, a successful check would indicate a high confidence that the displayed page is correct and complete.

If the page check fails the only possibility for error correction in the basic teletext system depends on the cyclic repetition of pages. A method of using an auxiliary 'flag' bit associated with each byte of the page store to allow such error correction has been described elsewhere[3] together with examples of its use.

## 3. Character repertoire

Table A3a in the annexed document shows the basic display character set of the UK teletext system, and Table A4a lists the differences between this set and two other national-variant character sets already in use with the UK teletext system elsewhere in Europe.

The UK teletext system is based on the concept of a 'fixed-format' where every address in the

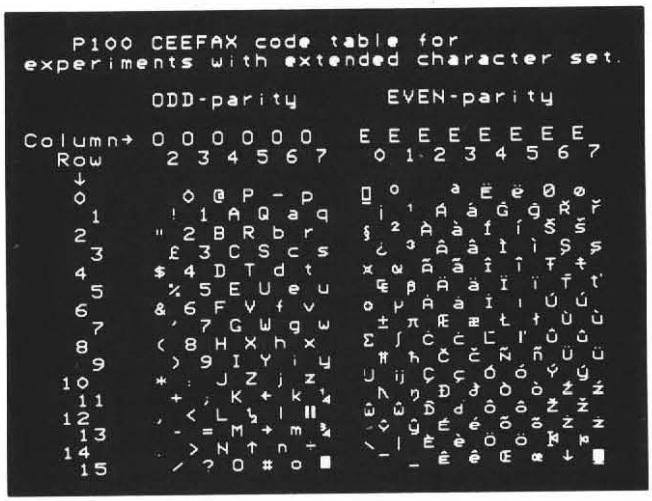



*Fig. 3 - An experimental extended character set*

page display store corresponds to a given character site within the page, and every stored code is either a display character or a control character. The present system uses seven-bit codes with 96 display characters and 32 control characters. In the annexed proposal it is assumed that eight-bit codes will be used in the page store, still with 32 control characters, but now with 224 display characters. This total is conveniently similar to the requirement for a common-core alphabet for the languages using the Latin alphabet, and allows languages to be mixed within a page. Fig. 3, which corresponds to the display characters listed in Table A3, shows the extended code table currently used in experiments. Two particular characters require comment, code E1/1 is a superscript 1 which can be used, together with superscript 2 and 3, to introduce footnotes or linked pages, and code E0/5 is allocated to the European Currency Unit (ECU) for which a temporary symbol has been devised.

The use of an eight-bit store also allows the size of the mosaic (formerly known as graphic) character repertoire to be more than doubled and an indication of the characters that could be used is given in Table A3b. It has already been recognised that the 48 diagonal mosaic patterns add greatly to the capabilities of the system.

### 3.1. Existing National Variants

If the existing national variants of the basic character sets, as listed in Table A4a, are to continue in use indefinitely a future decoder operating with an enhanced UK teletext system should be able to recognise which variant is in use and respond accordingly. It is proposed in A.2.3.1 that the three unused control bits in the page header be used for this purpose. There is no need to reduce the overall character repertoire or to provide different character generators because of these variants; all that is required is a permutation of some of the character codes under the control of these header control bits, as indicated in Table A4.

### 3.2. Implications of Use of Eight-Bit Codes

The use of the full eight bits of every transmitted character byte, which is presumed in the above extended character repertoire, means that many transmitted bytes will not satisfy an odd-parity check. At present all UK Teletext decoders use this check to prevent the writing of character bytes with 1, 3, 5 or 7 errors into storage. This prevents the appearance of wrong characters (other than the spaces which normally appear in place of characters not yet written) on the display when the received data is subject to isolated single bit errors. A decoder responding to eight-bit codes will, in general, display a wrong character whenever the received byte is in error.

It can be argued that the use of the page check word, together with possible use of the 'flag bit' technique, is sufficient to counter errors in teletext; in the vast majority of homes in the UK a properly functioning teletext installation suffers no errors at all on most days. If it is desired to retain the 'parity' type of error detection rows 26 or 27 of a page (see Annex B) can be used* to send, by a direct addressing technique, the locations of the few even-parity sites within a page.

Most UK Teletext decoders use the transitions of the data waveform for recovering the bit-rate clock, so it is prudent to restrict the use of the two bytes which could result in long periods without transitions (see A.1.2). In the code table these bytes have been assigned characters which have restricted use.

### 3.3. Further Extension of the Character Repertoire

Although a set of 96 characters is enough for many applications, and a common-core alphabet of some 220 characters is likely to meet the everyday needs of most broadcasters using languages written in a Latin alphabet, applications of broadcast teletext are envisaged where an even fuller repertoire is needed. This presents a problem when several million decoders are already in service and con-

* A technique proposed by Mr. W.J. Christis of N.V. Philips', Eindhoven.

sideration is given to adding more characters to the list, as it is impracticable to modify these decoders.

A more complete Latin alphabet character repertoire, together with a coding scheme, is the subject of an international standard in course of preparation.[4] If UK Teletext is required to handle this fuller repertoire, and its possible further extensions to other alphabets (Arabic, Cyrillic, Greek, Hebrew, etc), as part of a more general text transmission system, this could be done strictly in accordance with the ISO coding scheme and using the independent data channels available in teletext (see C.1). If these characters are to be used within conventional teletext pages it would be essential to have a 'fall-back' presentation on decoders not equipped with the increased and increasing repertoire. This is easily achieved using the concept of over-writing using directly addressed bytes carried by page-associated data channels (Annex B). A normal page is sent in the conventional fixed-format transmission, and this serves as the fall-back presentation on the normal decoder. A decoder capable of responding to the new characters will recognise their codes in the page-associated data channel and substitute them in place of the characters transmitted in the normal way. A detailed proposal for such a scheme, for use with the ISO draft standard for the Latin alphabet, and with Hamming protection for the address information, has been described by Philips' and is known as 'polyglot C'.[2] This technique can be used equally well with a 96-character basic repertoire or with a 220-character basic repertoire, although with the larger basic repertoire there are fewer occasions when the auxiliary rows would be needed in the page transmission.

## 4. Display modes

The display modes of UK teletext are known as 'serial' modes. Under the control of codes which occupy positions on the displayed page, these modes can be set and changed. The full list of modes and control codes is given in Table A2, and their action is detailed in A.3.1. In this table a new mode has been defined in addition to those given in the current specification;[5] this is the 'underline' mode which shares the same control codes as the separated mosaic mode. Another new feature is the provision for variable character spacing to improve the appearance of text, and a control code has been provided to allow tabulation to be preserved (see A.3).

The provision of 'parallel' modes for teletext is under active discussion. The intention is to allow most, if not all, of the modes to be changed between characters so that, for example, every letter of a word may be in a different colour on a different background colour. Clearly additional storage is required to handle these commands and in the extreme case the page display store for a parallel attribute system would need to be three times the size of a basic teletext page store.

If there is a need to accommodate parallel attributes they too can be provided in an enhanced UK teletext system by using the page-associated data channels to convey directly-addressed control words to modify the appropriate parts of the extended page display store. Such a system forms part of the 'polyglot C' proposal.

## 5. Data broadcasting

Data not intended for direct display of text on the screen may be coded in either of two ways, chosen according to the application, and in both cases the data transmissions will not interfere with the normal operation of teletext decoders designed to receive only pages of text.

### 5.1. Pseudo-Pages

When data is conveniently organised as blocks of up to 1K byte it can be treated as a teletext page which cannot be accessed by a normal decoder. As well as the 2½ million addresses available for normal pages there are more than 10 million additional addresses available for these 'pseudo-pages' (see A.2.1.3.1). Such data blocks can be linked together using the method described in 2.1 so that long sequences of data can be sent as packets, each being tested for integrity by means of the page check word. The concept of linked pages allows pseudo-pages to be coupled with normal pages of text which can then be used to introduce and comment upon the contents of the pseudo-pages.

Many uses can be found for such a data broadcasting system closely coupled to the teletext pages, and perhaps the most attractive is its use for sending pictures more intricate than pages of text. A teletext page requires about a kilobyte of memory, a high-quality still television picture requires about a megabyte. Between these extremes there is a large variety of uses, and the challenge is to find an efficient hierarchy of coding which will allow all intermediate cases to be handled effectively. For example, the normal resolution of the teletext mosaic mode (Fig. 4)


*Fig. 4 - Example of mosaic mode resolution*


*Fig. 5 - Example of picture-element resolution*


*Fig. 6 - Typical 'painting-by-numbers' picture*


*Fig. 7 - An RGB television picture inset in a teletext page*

can be dramatically improved if the shapes can be defined on a picture element basis (Fig. 5). If several bits per picture element are available the code for each picture element can represent one of a range of redefinable colours allowing a 'painting-by-numbers' type of picture to be handled (Fig. 6). With even more bits per picture element full RGB television picture quality can be achieved (Fig. 7) without the jagged edges usually associated with systems involving an approach based on discrete picture elements. Annex D discusses these points in more detail.

#### 5.2. Auxiliary Data Channels

Annex C.1 indicates how UK Teletext can be used to provide 15 data channels independent of each other and independent of the normal teletext service. This resource can be used for any purpose and the data lines can be added or removed without affecting the accompanying teletext signal. The channels can, of course, be subdivided further if required.

#### 5.3. Television Service Data-Line

Annex C.2 indicates how a data-line, repeated perhaps every second, could be reserved for purposes associated with the television channel (such as programme identification), associated with the teletext service (the complete address of an initial introductory page) or unrelated to either television or teletext (a statement of the day, date and time). As with the auxiliary data channels the use of this

data line does not interfere with the operation of normal teletext decoders.

#### 5.4. Framing Code

It has been suggested that the distinction between different uses of a data broadcasting system can be made by using different framing codes. The methods described above all use the normal data-line preamble (clock run-in and framing code) and rely on the subsequent Hamming-coded bytes for distinguishing the applications. Only when byte synchronisation is properly achieved can data lines be reliably accepted or rejected; when more than one framing code is in use the possibilities of obtaining false byte synchronisation are significantly increased.

## 6. Background to annexed draft specification

During the discussions in the meeting of the EBU Sub-group V2 (Data Broadcasting) two themes became apparent. First, there was a general desire that the different systems already in use and about to be used should be developed in the future in such a way that they converge in their capabilities, even though the particular strengths and weaknesses of the basic systems would remain. This convergence of capabilities should as far as possible also apply to the viewdata (Videotex) systems. Secondly, there was a strong wish from the many countries already using UK Teletext in a more or less experimental way that a unique path of development of UK Teletext should be specified. Ideally, their urgent needs, notably the common-core character set, would be accommodated immediately and the means by which other material, such as data not intended for direct display as pages of text and data for programme labelling, could be carried would be defined. The most important point was that any development of UK Teletext should not render existing decoders obsolete; the broadcaster should be able to continue to transmit current pages in the same way. This compatibility should still apply as enhancements are added. It is against this background that a working document GT V2 169, 'Draft Specification of an Enhanced Teletext System using Direct Coding', which is reproduced here as Annexes A, B and C, was prepared in January 1980. The structure of the main part of this document (Annex A) follows exactly that of the September 1976 Broadcast Teletext Specification.

## 7. Conclusion

This paper has shown how UK Teletext can be used as a basis for a hierarchy of future developments embracing all the anticipated features of other systems and leading to a capability to transmit colour pictures whose quality is limited only by the display device itself. Throughout such a path of development the efficiency and ruggedness of the basic UK Teletext system can be preserved.

## 8. References


1. European Broadcasting Union, Brussels, 1980. Technical Document No. 3232. Displayable character sets for broadcast teletext.

2. CROWTHER, G.O. Adaptation of UK Teletext System for 525/60 operation. IEEE Chicago Spring conference, 1980.

3. CHAMBERS, J.P. Teletext alphabets and error protection. EBU Review, Technical, No. 173, February 1979.

4. ISO document TC97/SC2/WG4/N222. Sixth working draft for an international standard. Part 2: Latin alphabets and non-alphabetic graphic characters. Edited by L.J. Zeckendorf, April 1980.

5. Broadcast Teletext Specification BBC/IBA/BREMA, September 1976.

## ANNEX A

## A DRAFT AMENDED UK TELETEXT SPECIFICATION

## SUMMARY

*This draft specification defines an enhanced teletext system for broadcasting information accompanying, but not necessarily related to, a television signal. The main technical features of the system are:*

*(1) The enhanced teletext system includes all the features of the existing UK teletext system for transmitting pages of text and elementary pictorial information in coded form on otherwise unused television lines during the field-blanking interval. Moreover, it provides an extended alphabet adequate for text in the majority of languages using the Latin alphabet, together with the possibility of using other alphabets.*

*(2) The system uses binary signalling at 6.9375 Mbit/s during each data-line. It is directly applicable to terrestrial broadcasting using 625/50 television systems with video bandwidths 5.0 MHz or greater. Using two data-lines per field the system allows at least four pages to be transmitted every second.*

*(3) Up to eight independent teletext magazines may be multiplexed onto a single television signal. Each magazine can contain up to 320 000 different teletext pages addressable individually or in groups or sequences by the user. Over a million addresses in each magazine are available for sending blocks of data each up to one Kilobyte in size, and not necessarily related to teletext pages, as pseudo-pages.*

*(4) The address and control information is well protected by a rigid format and the use of Hamming codes. This substantially eliminates the possibility of all or part of an unwanted page being mistaken for wanted data. A check for complete and correct reception of pages is provided. This can be used to freeze the correct page in storage, and to start the next operation in an automatic data capture process.*

*(5) Each teletext page can carry the address of up to five subsequent and one previous related page. This allows a page structure based on a decision tree to be followed with minimum instructions from the user. In decoders equipped with multi-page memories this feature can be used to give apparently immediate access to the next wanted page.*

*(6) A facility for underlining text, and an extended character set to allow improved presentation of pictorial material, are provided.*

*(7) The system provides a television data-line. This can be used to send information about the accompanying television programme for display on the screen and for automatic control purposes. It can contain the address of an initial teletext page to be selected automatically by a teletext decoder. It also can carry a statement of current time with supplementary information to allow the day and date to be displayed.*

*(8) The system offers 15 auxiliary data channels, independent of teletext and of each other. They may be subdivided at will, and used for any purpose, teletext acting solely as the carrier.*

*(9) The system can be extended to provide for the transmission of a sequence of still colour television frames whose quality is limited only by the display device. Any intermediate requirement between this and teletext pages can be coded efficiently to exploit any redundancy and retaining the maximum compatibility with the basic system.*

## INTRODUCTION

This document defines an enhanced teletext system compatible with, and using the direct-coding principles of, the UK system. Much of the detailed information is carried by figures and tables. The description is in four sections.

The first section describes how binary code groups are formed into Data-Lines for inclusion in the television field-blanking interval.

The second section describes how the control and address information carried on each Data-Line, together with the special Page-Header Data-Lines and the sequence of transmission of the Data-Lines, allow the Data-Lines corresponding to the Rows of a selected Page to be identified. The Page structure can be used to send information other than Pages of text. Certain Data-Lines can be used for functions unrelated to Teletext.

The third section describes how the Character Codes received on the Data-Lines corresponding to the Rows of the selected Page are interpreted to give a Page display.

The fourth section defines Teletext terms.

### A.1. Television Data-Lines

The television signal includes unused lines in the field-blanking interval to allow time for field flyback in receivers before each active field begins. The duration of this interval is usually 25 lines, and some of the later lines are used by broadcasters for test and signalling purposes.

This system can use up to 16 of these unused lines as Data-Lines (see Fig. A1). Initially lines 17(330) and 18(331) are being used but other lines may be used.

A line in the field-blanking interval is identified as a Teletext Data-Line by the presence of the Clock Run-In (see A.1.2.1) followed by the Framing Code (see A.1.2.2) at an appropriate time.

#### A.1.1. Data-Line Waveform

Each Data-Line contains binary elements (bits) as a two-level NRZ (Non-Return-to-Zero) signal, suitably shaped by a filter.

##### A.1.1.1. Data Levels

The binary signalling levels are defined in a scale where television black level is 0% and white level 100% (see Fig. A2). The binary '0' level is then 0(±2)% and the binary '1' level is 66(±6)%. The difference between these levels is the basic data amplitude. The data waveform will contain overshoots so the peak-to-peak data amplitude will exceed the basic data amplitude.

The basic data amplitude may vary from Data-Line to Data-Line.

##### A.1.1.2. Bit Rate

The binary element signalling rate is 6.9375 Mbit/s (±25 parts per million).

It is 444 times the nominal television line frequency.

##### A.1.1.3. Data Timing

The data timing reference point is the peak of the penultimate '1' of the Clock Run-In sequence (see Fig. A3). This point has been selected to reduce the effect of any transient distortions at the start of the Data-Line.

The line time reference is the half-amplitude point of the leading edge of the line synchronising pulse.

The data timing reference in the signal as transmitted shall be 12.0(+0.4/−1.0)μs after the line time reference.

The data timing may vary from Data-Line to Data-Line.

##### A.1.1.4. Data Pulse Shape

The spectrum of the generated data pulses, which is the produce of the spectrum of the basic NRZ data waveform and that of a phase-corrected

shaping filter, is indicated in Fig. A4. To minimise intersymbol interference the spectrum is substantially skew-symmetrical about a frequency corresponding to one-half of the bit rate. There is minimal energy above 5.0 MHz.

The corresponding one-bit pulse is indicated in Fig. A5.

#### A.1.2. Data-Line Structure

Each Data-Line comprises 360 bits which may be considered at 45 eight-bit Bytes.

The first three Bytes, which have even parity, serve to synchronise the bit and Byte recovery operation in the receiver. The remaining 42 Bytes carry address and control information and, when forming part of a Teletext Page, the codes just sufficient for a complete Row of characters in the Page.

The codes used to send Pages avoid the bytes 00000000 and 11111111. This ensures that there are never more than 14 bit periods between the data level transitions in the waveform. This simplifies the recovery of the bit-rate clock directly from the data waveform.

All the address and Page control information is transmitted using Hamming Code Bytes to reduce the possibility of the wrong Data-Lines being stored in the receiver.

##### A.1.2.1. Clock Run-In

The first two Bytes of every Data-Line comprise the Clock Run-In sequence of alternating bits, beginning 101010....., to indicate the presence of a Data-Line and to establish the timing of the bits on that line (see Fig. A6).

In some circumstances the first one or two binary '1's may be absent.

##### A.1.2.2. Framing Code

The third Byte of every Data-Line comprises the Framing Code 11100100. This code has been selected to enable Byte synchronisation to be established even if one bit of the Framing Code has been wrongly received.

Fig. A9 indicates how incoming data are compared with the Framing Code pattern. It shows that a test for any seven corresponding bits will give a correct indication of the Framing Code in the presence of a single error.

##### A.1.2.3. Hamming Codes

The fourth and fifth Byte of every Data-Line, and a further eight Bytes of the Page-Header Data-Lines, are Hamming Codes containing four 'message' bits interleaved with four 'protection' bits dependent on the message bits as listed in Table A1a. The bits are transmitted in numerical order from $b_1$ to $b_8$.

Table A1b details four parity tests that can be made on the received Byte. Table A1c shows how the results of these tests can be used to correct single errors in the received Byte and detect double errors. When more than two bits of a Byte are in error this process may result in a false message being decoded.

Fig. A6 shows the locations and lists the functions of all the Hamming 'message' bits. When error correction is used the decoded message bit may differ from the corresponding bit in the Data-Line as the bits of the Hamming Code Byte are interdependent.

##### A.1.2.4. Character Bytes

The remaining Bytes of each Data-Line are eight-bit Character Codes (see Table A3).

The bits are transmitted in numerical order from $b_1$ to $b_8$.

### A.2. Organisation of Pages and Rows

#### A.2.1. Addresses

##### A.2.1.1. Magazine and Row Address Group

Every Data-Line contains two Hamming Codes signifying a three-bit Magazine number and a five-bit Row address (see Fig. A6), or an Independent Data-Line.

The Magazine number is in the range 1—8, Magazine 8 corresponding to the bits 000 and the others being directly the number obtained with the bit weights given in Fig. A6.

The Row Address is in the range 0—29 and is the number obtained with the message bit weights given in Fig. A6. Data-Lines with Row address 0—23 are used for the 24 Rows of a Teletext Page, or as part of a Pseudo-Page. The functions of Rows 24—29 are given in Annex B. The bit patterns representing Row Addresses 30 and 31 relate to Independent Data-Lines (see

Annex C.1), and have no corresponding Magazine number.

#### A.2.1.2. Page-Header

Data-Lines with Row address 0 are Page-Headers, which contain eight additional Hamming Code Bytes with message bits relating to that Page, including the two digits of the Page number and the four-digit Subcode (see Fig. A6). The display and control functions of the other message bits are detailed in A.2.3 below.

##### A.2.1.2.1. Page Service Row

Data-Lines with Row address 29 are Page Service Rows (see Annex B).

#### A.2.1.3. Teletext Page Identification and Subcode

Each Teletext Page is identified by its single-digit Magazine number (1—8) and its two-digit Page number (00—99).

Different Pages with the same Magazine and Page numbers may be identified by invoking a four-digit Subcode whereby up to 3200 versions of that Page may be individually selected and held.

For this purpose the four digits of the Subcode can take values in the range 0—3, 0—9, 0—7, 0—9, so they can be used to express a clock-time in hours and minutes.

##### A.2.1.3.1. Identification of Pseudo-Pages

A Pseudo-Page, not intended for display as a Teletext Page, is allocated a Page number with at least one of the digits in the range 10—15, there being 156 such Pseudo-Page numbers available for each Magazine.

Each of these Pseudo-Page numbers can be associated with any of the 8192 Subcodes obtainable by using the full ranges of the four digits viz. 0—3, 0—15, 0—7, 0—15.

#### A.2.1.4. Page Selection

A Page, or a Pseudo-Page, may be selected by its Magazine number and Page Number regardless of the Subcode, or by its Magazine number, Page number and Subcode.

A decoder may be provided with the facility to ignore one or more digits of the Page number or Subcode in order to capture a sequence of Pages.

### A.2.2. Transmission Sequence

#### A.2.2.1. Pages

The transmission of a selected Page begins with, and includes, its Page-Header and ends with, and excludes, the next Page-Header of the selected Magazine number. All the intermediate Data-Lines carrying Row addresses in the range 0—29, and the selected Magazine number, relate to the selected Page.

Pages may be transmitted in any order. Occasionally incomplete Pages may be transmitted. Rows from Pages of different Magazine number may be interleaved in any way.

#### A.2.2.2. Rows

The Rows of a Page may be transmitted in any order. Rows, including the Page-Header, may be repeated in which case the latest information should take precedence. Rows containing no information for display need not be transmitted.

#### A.2.2.3. Page Erasure Interval

Rows will be transmitted such as to allow an active television field period between an initial Page-Header and further Rows sufficient to complete the transmission for that Page.

This allows one display period for the receiver Page store to be erased when necessary.

### A.2.3. Page-Header Structure

The Page-Header Data-Lines (see A.2.1.2) contain eight Hamming Code Bytes in place of the first eight Character Bytes of the other Data-Lines (see Figs. A6 and A7).

There are thus only 32 Character Codes in a Page-Header. They are used to present general information for display, such as the Magazine and Page number, the day and date and the programme source. In particular, the last eight characters are reserved for the display of material common to the entire magazine, such as clock-time. Examples of the content of a Page-Header are given in Fig. A7a.

The locations of the 32 address and control message bits of the eight Hamming Codes peculiar to a Page-Header are shown in Fig. A6. This also shows the binary weights of the eight Page number, and 13 Time Code, bits whose functions are

described in A.2.1. The remaining 11 bits are Control Bits numbered $C_4$ to $C_{14}$ whose functions are described below.

#### A.2.3.1. Control bits (see Fig. A6)

$C_4$ Erase Page. This Control Bit is set to '1' when the information on that Page is significantly different from that in the previous transmission of the Page bearing the same Magazine and Page number, such that the two should not be confused.

Its use will always be followed by a Page erasure interval (see A.2.2.3).

$C_5$ Newsflash Indicator. This Control Bit is set to '1' on a Page designated as a 'Newsflash' Page, whether or not it currently contains information. All information intended for display on such a Page will be Boxed (see A.3.1.5). This Control Bit may be assigned a different function on Pseudo-Pages.

$C_6$ Subtitle Indicator. This Control Bit is set to '1' on a Page designated as a 'Subtitle' Page, whether or not it currently contains information. All information intended for display on such a Page will be Boxed (see A.3.1.5). This Control Bit may be assigned a different function on Pseudo-Pages.

$C_7$ Suppress Header. This Control Bit is set to '1' when the Page is better displayed without the characters of the Page-Header. This Control Bit may be assigned a different function on Pseudo-Pages.

$C_8$ Update Indicator. This Control Bit may be set to '1' when part or all of a Page contains later information than that in the previous transmission of the Page bearing the same Magazine and Page number. The 'Update' Page transmission may be incomplete containing only the updated Rows of a Page (see A.2.2.1).

$C_9$ Interrupted Sequence. This Control Bit is set to '1' when a Page is being transmitted out of strict numerical sequence in order to give it priority (such as a Subtitle Page) or more frequent transmission (such as an Index Page).

It allows the Page-Header to be suppressed when Rolling Headers are displayed, to avoid discontinuities in the displayed Page numbers.

$C_{10}$ Inhibit Display. This Control Bit is set to '1' when the contents of a Page cannot usefully be interpreted as a Teletext transmission using the coding variant signalled by $C_{12}$, $C_{13}$, $C_{14}$. It can be used to introduce a further eight coding variants.

$C_{11}$ Magazine Serial. This Control Bit is set to '1' when the transmission sequence of Magazines and Pages is such that it is preferable to display all Page-Headers as Rolling Headers rather than only those of the selected Magazine.

$C_{12}$, $C_{13}$, $C_{14}$ Coding Variant. This three-bit code is used to identify one of eight variants of the code table. Decoders may be equipped to respond to this code in order to operate automatically with more than one variant (see Table A4).

### A.3. Page Display

None of this section necessarily applies to Pseudo-Pages.

The 24 Rows of a Page are numbered sequentially from 0 (Page-Header, top Row) to 23. The 40 Character Rectangles of a Row are directly related to the 40 Character Bytes of the corresponding Data-Line, each being assumed to be scanned sequentially from left to right (see Fig. A7).

A decoder may be equipped to provide variable character spacing along a Row in order to improve the appearance of the text. In this case it is desirable that the maximum character spacing is that of the character rectangles and the numerals 0–9 should all have this spacing. Throughout the Mosaic Mode all characters are to be displayed in character rectangles directly corresponding to their position on the Data-Line. The use of the Mosaic Release Control Character (O1/15) implies that the subsequent character should be displayed in a character rectangle directly corresponding to its position on the Data-Line.

Every Character Byte contains a Character Code which represent either a Display Character or a Control Character. The Control Characters are used to establish Display Modes, which may be changed between Character Rectangles within a Row.

The Display Modes determine how a Display Character Code is interpreted as a character to be generated in the corresponding Character Rectangle of the Page display. The Character

Rectangles corresponding to Control Character Codes are generally displayed as Spaces (but see A.3.1.7).

#### A.3.1. Display Modes

The Display Modes are listed in Table A2 as complementary pairs; those on the left are assumed at the start of every Row. The Control Character Codes listed with each mode are used to initiate that mode.

Some Control Characters have immediate effect ('set at') in that the new mode obtains for and from the corresponding Character Rectangle, others have subsequent effect ('set after') when the new mode obtains for and from the next Character Rectangle. A later Control Character takes precedence over an earlier one.

When a Control Character signifies a change to a mode already obtaining, that mode generally continues uninterrupted throughout the corresponding Character Rectangle (but see A.3.1.3).

In general the Character Codes of a Row are sufficient to define the entire display of that Row (but see A.3.1.6).

The interpretation of the Display Modes is detailed below.

##### A.3.1.1. Character Set

Three overlapping sets of 222 Display Characters are available for the interpretation of the 222 unrestricted Display Character Codes.

During the Alphanumeric Mode the Alphanumeric Set applies. During the Mosaic Mode the Contiguous Mosaic Set applies during the Contiguous Mode and the Separated Mosaic Set applies during the Separated Mode.

##### A.3.1.2. Display Colour

One of the seven colours white, yellow, cyan, green, magenta, red, blue is used to depict the Display Character in the Character Rectangle. Seven pairs of Control Characters are available so that the Display Colour and/or the Alphanumeric/Mosaic Mode may be changed by a single Control Character. There is a direct correspondence between bits $b_1$, $b_2$, $b_3$ of these codes and the red, green and blue components of the colours.

##### A.3.1.3. Background Colour

The Background Colour of the Character Rectangles is black during the Black Background mode. Whenever the new background Control Character O1/13 (see Table A3) occurs the Display Colour then obtaining is adopted as the Background Colour in the new background mode.

##### A.3.1.4. Conceal and Flash

Two modes are provided wherein all the Display Characters are displayed as Spaces at certain times. All characters in the Conceal mode are intended to be displayed as Spaces until the Reveal mode is restored after a time delay in the receiver or by user control. All characters in the Flash mode are intended to be displayed alternately as they would otherwise be displayed, and as Spaces, under the control of a timing device in the receiver.

##### A.3.1.5. Boxing

All characters intended for display on Newsflash and Subtitle Pages will be in the Boxed Mode, which defines the part of the Page which is to be inset into the normal television picture. This inset operation may be controlled automatically by the Control Bits $C_5$ or $C_6$ (see A.2.3.1).

Some or all of the characters on any other Pages may be Boxed, the Boxed Mode then defines a part of the Page which may be inset into the normal television picture under user control as an alternative to the display of the complete Page alone, or superimposed on the picture.

In order to give protection against spurious Boxing, two consecutive Start Box Control Characters O0/11 (see Table A3) will be transmitted to start the Boxed Mode and two consecutive End Box Control Characters O0/10 will be transmitted to terminate that mode. The mode changes occur between the corresponding consecutive Character Rectangles.

##### A.3.1.6. Double Height

Whenever the Double Height mode occurs the information in that Row is sufficient to define the display of both that Row and the Row of next higher address. A receiver responding to the Double Height mode on a Row must ignore any information received for the Row of the next higher address, but a receiver not responding to this mode will operate normally on both Rows.

A receiver responding to one or more occurrences of the Double Height mode in Row 'R' will operate as otherwise during that Row except that in every Character Rectangle during the Double Height mode only the upper half of what would otherwise have been displayed is displayed, stretched vertically to fill the rectangle. On Row 'R+1' the corresponding lower half of each of these is similarly displayed. The remaining Character Rectangles of Row 'R+1' are to be displayed as unboxed Spaces in the same Background Colour as the corresponding Character Rectangles of Row 'R'.

#### A.3.1.7. Hold Mosaic

Generally all Control Characters are displayed as Spaces, implying at least one Space between rectangles with different Display Colours in the same Row. The Hold Mosaic mode allows a limited range of abrupt Display Colour changes by calling for the display of a Held Mosaic Character in the rectangle corresponding to any Control Character occurring during the Mosaic Mode. This Held Character is displayed in the modes obtaining for the rectangle in which it is displayed, except for the Contiguous/Separated Mode which forms part of the structure of the Held Mosaic Character.

The Held Mosaic Character is only defined during the Mosaic Mode. It is then the most recent character with $b_6$=1 in its character code, providing that there has been no intervening change in either the Alphanumeric/Mosaic or the Normal/Double Height modes. This character is to be displayed in the Contiguous or Separated Mode as when it was first displayed. In the absence of such a character the Held Mosaic Character is taken to be a Space.

#### A.3.1.8. Underline

Only while the Underline and Alphanumeric Modes together obtain, all Display Characters (i.e. excepting Spaces corresponding to Control Characters) are displayed with an underline or with another distinct attribute capable of indicating emphasis even on a monochrome display.

### A.4. Definition of Teletext Terms

**Access Time** – The time between selecting a Page at a receiver and the first complete reception of that Page.

**Alphanumerics Character** – One of the 224 Display Characters listed in columns O2–O7, and E0–E7 of Table A3. The shapes of the characters are not defined but they should all be different and recognisable (other than the two Spaces O2/0 and E2/0).

**Alphanumerics Mode** – The Display Mode in which the Display Characters are those of the Alphanumerics Set.

**Alphanumerics Set** – The set of 224 Display Characters comprising all the Alphanumerics Characters.

**Auxiliary Data Channel** – One of 15 data channels each corresponding to a unique Magazine and Row Address Group on a Teletext Data-Line. The Data-Lines of Auxiliary Data Channels can be interleaved in any way with each other or with Data-Lines carrying Teletext Pages or Pseudo-Pages. Auxiliary Data Channels can be used to carry information for any purpose, Teletext being used solely as the carrier (see Annex C.1).

**Background Colour** – The colour filling the parts of the Character Rectangle not occupied by the character itself (see Fig. A8). The Background Colour may be black or one of the seven Display Colours. It may be changed within a Row by Control Characters.

**Blast-Through Alphanumerics** – The use of the 32 Alphanumerics Characters of columns O4 and O5 of Table A3 during the Mosaic Mode.

**Boxed Mode** – The Display Mode in which, under the user's control, the characters are intended to be inset or added to a television picture. When a Newsflash or Subtitle is transmitted this operation may be automatic under the control of Control Bits.

**Byte** – A group of eight consecutive data bits intended to be treated as an entity.

**Character Byte** – The Byte corresponding to a Character Code.

**Character Code** – An eight-bit binary number representing one of a set of Display Characters, or a Control Character.

**Character Rectangle** – One of the 960 units in the regular matrix of 24 Rows of 40 sites in which characters are generated in the display of a Page.

**Character Row** – see Row.

**Clock Run-In** – A sequence of alternating bits at the start of a Data-Line to allow a receiver to achieve bit synchronisation.

**Conceal** – A Display Mode during which all characters, although stored in the receiver, are intended to be displayed as Spaces until the viewer chooses to Reveal them.

**Contiguous Mosaic Set** – The set of 224 Display Characters comprising the 64 Contiguous Mosaic Characters listed in columns O2a, O3a, O6a and O7a of Table A3a, together with the 32 Blast-Through Alphanumeric Characters of columns O4 and O5 and the Characters listed in columns E0a to E7a of Table A3b.

**Contiguous Mode** – The Display Mode in which the six cells of the Mosaic Characters fill the Character Rectangle (see Fig. A8).

**Control Bits** – Each Page-Header contains 11 Control Bits to regulate the display of the Page and its header (see A.2.3.1).

**Control Character** – One of the 32 characters listed in columns O0 and O1 of Table A3a. Five of these are reserved for future use. The others are used to alter the Display Modes. They are usually displayed at Spaces (but see A.3.1.7).

**Data Channel Address** – When the last four message bits of the Magazine and Row Address Group of the Page-Header (see Fig. A6) are 1111 the first four bits becomes the data channel group (see Annex C.1) and give the Data Channel Address.

**Data-Line** – One of the otherwise unused lines of the television field-blanking interval used to carry information for one Teletext Character Row. A Data-Line is identified by the Clock Run-In sequence followed by a Framing Code at the appropriate time on a line in the field interval.

**Display Character** – One of the different shapes which can be generated in a Character Rectangle as part of a Page. There are Alphanumeric Characters to provide text and Mosaic Characters to provide elementary pictorial information. There are three sets, the Alphanumeric Set, the Contiguous Mosaic Set and the Separated Mosaic Set, each of 224 Display Characters, some of which are common.

**Display Colour** – One of the seven colours (white, yellow, cyan, green, magenta, red, blue) used to depict a Display Character against the Background Colour in a Character Rectangle (see Fig. A8). The Display Colour may be changed within a Row by Control Characters.

**Display Mode** – The way in which the Character Codes corresponding to Display Characters are interpreted and displayed depends on Display Modes established by previous Control Characters (see Table A2). These modes may be changed within a Row, and an initial set of modes is defined for the start of a Row.

**Flash** – A Display Mode in which all characters are intended to be displayed alternately as they would otherwise be displayed, and as Spaces, under the control of a timing device in the receiver.

**Framing Code** – A Byte following the Clock Run-In sequence, selected to allow the receiver to achieve Byte synchronisation even if one of its bits is wrongly decoded.

**Hamming Code** – In the Teletext system a Hamming Code is a Byte containing four message bits and four protection bits as indicated in Table A1. A single bit error in such a Byte can be corrected. Hamming Codes are used for sending address and control information.

**Hold Mosaic** – A Display Mode in which any Control Character occurring during the Mosaic Mode results in the display of a Held Mosaic Character (see A.3.1.7).

**Independent Data-Line** – Certain Data-Lines, although in the Teletext format, are unrelated to the Data-Lines of Teletext Pages and Pseudo-Pages and may be interleaved in any way with these Data-Lines or with each other. One of these Data-Lines is the Television Service Data-Line (see Annex C.2), the others are structured as Auxiliary Data Channels (see Annex C.1).

**Initial Teletext Page** – The Television Service Data-Line includes the Magazine, Page and Sub-code numbers of a Teletext Page. This Page can be acquired automatically in a decoder before the user even chooses to view Teletext. By use of the Page Service Row of this Initial Teletext Page, further Pages can be made available in decoders with multiple Page stores.

**Linked Pages** – The Page Service Row allows each Page to be labelled with the address of up to six related pages. A user of a suitably-equipped decoder could access any of these Linked Pages with a single keystroke. A decoder with seven or more Page stores could acquire all the Linked Pages

as soon as possible after each Page is acquired for viewing. This will reduce or even eliminate the apparent Access Time.

**Magazine** – A group of up to a hundred Pages, each carrying a common Magazine number in the range 1–8. Up to eight Magazines may be transmitted in sequence or independently on a television programme channel.

**Mosaic Character** – One of 224 different Display Characters listed in columns O2a, O3a, O4, O5, O6a, O7a and E0a to E7a in Table A3. Those in columns O2a, O3a, O6a and O7a are based on the division of the Character Rectangle into six cells, the cells being Contiguous or Separated. The corresponding character codes have $b_6=1$ and odd parity; there is a direct correspondence between the other six bits of the code and the states of the six cells of the Character Rectangle. Examples are given in Fig. A8.

**Mosaic Mode** – The Display Mode in which the Display Characters are those of one or other of the Mosaic Sets, depending on whether the Contiguous or Separated Mode obtains.

**Mosaic Set** – See Contiguous Mosaic Set and Separated Mosaic Set.

**Newsflash Page** – A Teletext Page in which all the information for display is Boxed, and Control Bit $C_5$ is set to allow this information to be automatically inset or added to a television picture.

**Page** – See Teletext Page, Pseudo-Page.

**Page-Header** – A Page-Header Data-Line has Row address '0' and it separates the Pages of a Magazine in the sequence of transmitted Data-Lines. In place of the first eight Character Bytes it contains Hamming Coded address and control information relating to that Page. Thus the corresponding top Row of the Page has only 32 Character Bytes. These are used for the transmission of general information such as Magazine and Page number, day and date, programme source and information common to the entire magazine.

**Page Check Word** – A 16-bit word formed from the bytes of a Page or Pseudo-Page using a cyclic redundancy check (CRC) technique can be sent with the Page using the Page Service Row (see Annex B). This allows an automatic check of the correct and complete acquisition of the Page to be made before a subsequent operation.

**Page Service Row** – Every Teletext Page or Pseudo-Page may include a Page Service Row (Row 29) containing a Page Check Word and the addresses of Linked Pages (see Annex B).

**Plain** – The Display Mode complementary to the Underline Mode.

**Pseudo-Page** – A block of up to 1024 Bytes of data transmitted using the Teletext Page format but with the Page number outside the normal range for Teletext Page selection. They may be accessed by using automatic addressing based on the information contained in the Page Service Row of Teletext Pages or of other Pseudo-Pages. This allows them to be associated with one or more Teletext Pages. Rows 24 and 25 may be used to carry part of the data block. The data block is not intended for display as a Teletext Page, so Section A.3 of this document does not necessarily apply to Pseudo-Pages. The data block may be used to implement a high-definition Teletext system (see Annex D).

**Release Mosaic** – The Display Mode in which Control Characters are invariably displayed as Spaces. It is complementary to the Hold Mosaic Mode.

**Reveal** – The Display Mode complementary to the Conceal Mode.

**Rolling Headers** – The use of the top Row of the Page to display all the Page-Headers of the selected Magazine (see A.2.3.1 – Magazine Serial) as they are transmitted. This gives an indication of the Page transmission sequence while the user is watching, or awaiting, a selected Page.

**Row** – A Teletext Page comprises 24 Rows of characters. When displayed on a television screen each Row occupies about 20 television display lines. Each Row is generated from the information on one television Data-Line. It is to avoid confusion with television 'lines' that Teletext Pages are said to contain 'Rows' (see Pseudo-Page).

**Row-Adaptive Transmission** – Teletext transmission in which Rows containing no information are not transmitted. This reduces the access time of the system. The non-transmitted Rows are displayed as Rows of unboxed black Spaces and are assumed to contain the odd-parity NULL character (O0/0) throughout.

**Separated Mosaic Set** – The Set of 224 Display Characters comprising the 64 Separated Mosaic Characters corresponding to the Contiguous Mosaic Characters listed in columns O2a, O3a, O6a

and O7a of Table A3a, together with the 32 Blast-Through Alphanumerics Characters of columns O4 and O5 and the Mosaic Characters of columns E0a – E7a of Table A3b.

**Separated Mode** – The Display Mode in which there is a Background Colour boundary around and between the six cells of the Mosaic Characters of Table A3a within the Character Rectangle (see Fig. A8).

**Space** – A Character Rectangle entirely filled by the background colour.

**Subcoded-Page** – In addition to a Magazine number and Page Number a Teletext Page may be assigned one of 3200 four-digit Subcodes. This may be used to select one of many Pages, transmitted in sequence, bearing the same Magazine and Page number. When the transmission of a version of a Page is isolated or infrequent this Subcode may, for convenience, be chosen to correspond with the clock-time at which the Page is transmitted, expressed in hours and minutes. The number of Subcodes available for use with Pseudo-Pages is 8192 (see A.2.1.3).

**Subtitle Page** – A Page in which all the information for display is Boxed, and Control Bit $C_6$ is set to allow this information to be automatically inset or added to a television picture.

**Teletext** – A digital data broadcasting service associated with a television signal and primarily intended to display pages of text or elementary pictorial material on the screens of suitably-equipped television receivers.

**Teletext Page** – A group of 24 Rows of 40 characters intended to be displayed as an entity on a television screen.

**Television Service Data-Line** – A Teletext Data-Line unrelated to any others and capable of use at any time has been provided to allow the Teletext resource to be used to send information about the accompanying television service, to link the televison and Teletext services, and to send data, day and time information (see Annex C.2).

**Underline** – A Display Mode available during the Alphanumeric Mode allowing words or strings of words of text to be underlined or otherwise emphasised.

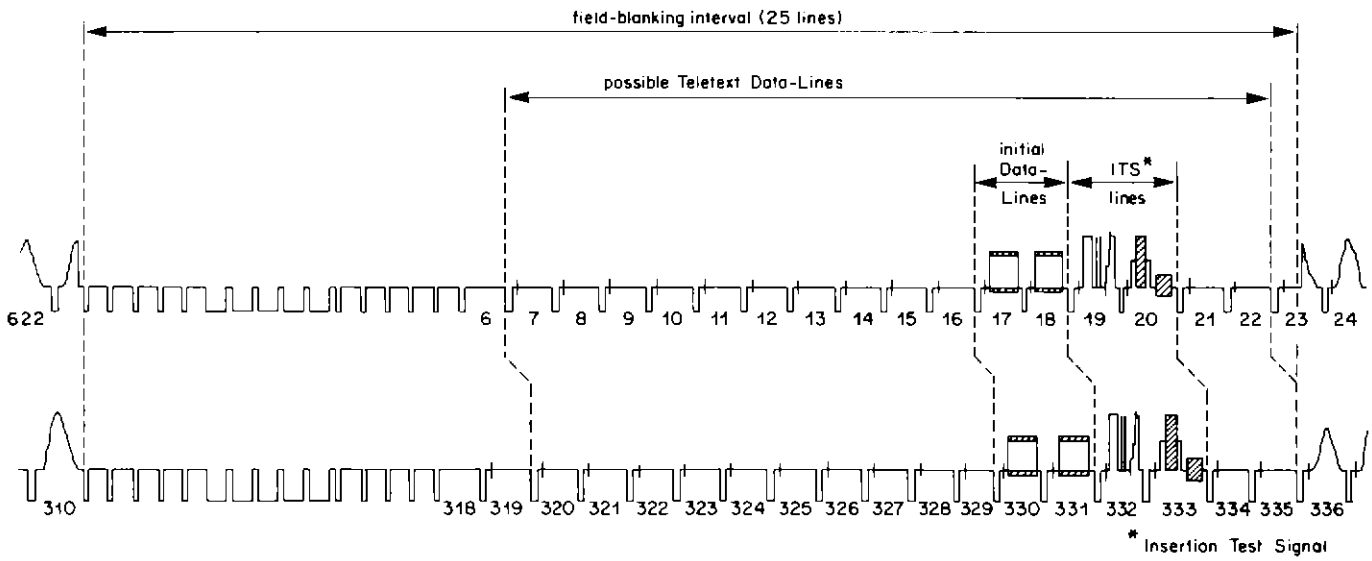



*Fig. A1 - Teletext Data-Lines (625-line television systems)*

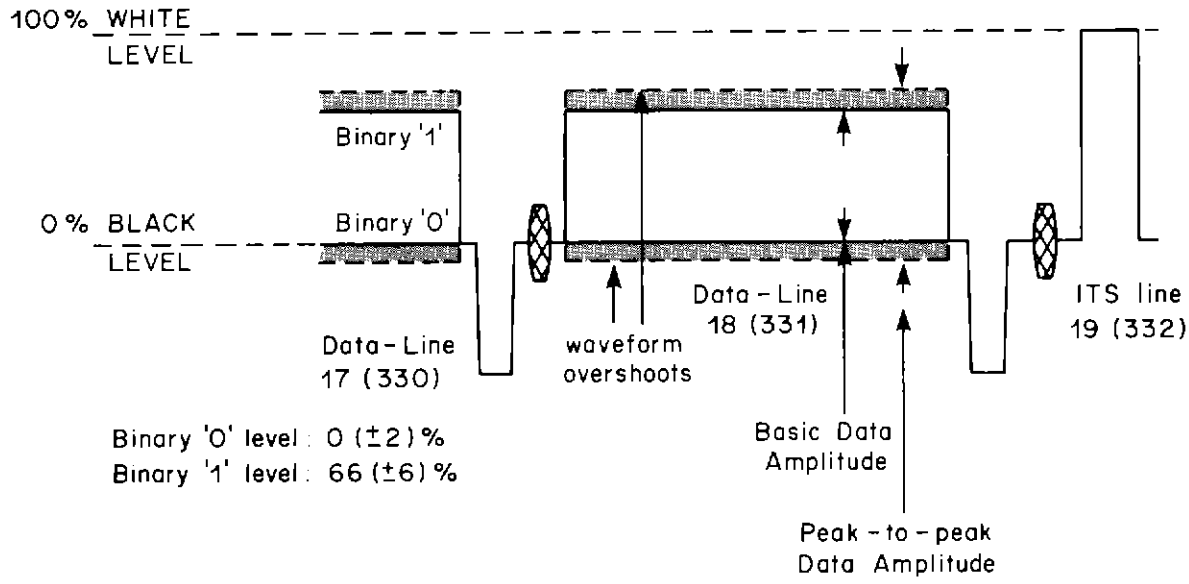



*Fig. A2 - Data levels*

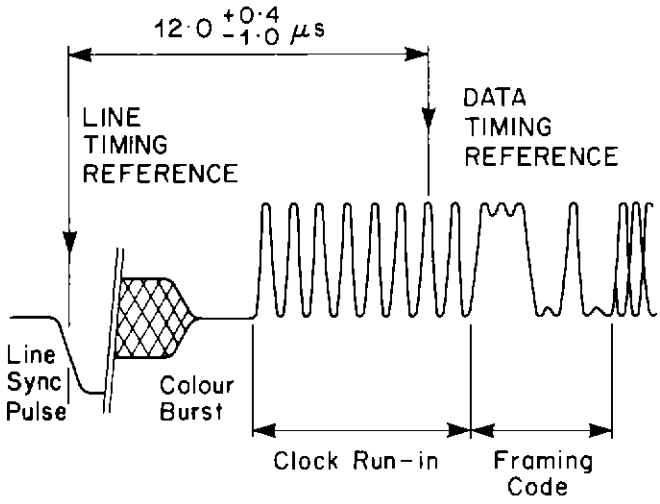



*Fig. A3 - Data timing*

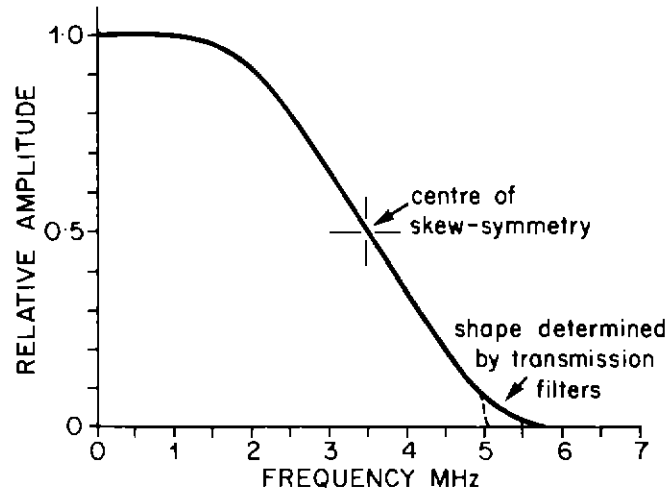



*Fig. A4 - An approximate spectrum of a data pulse*

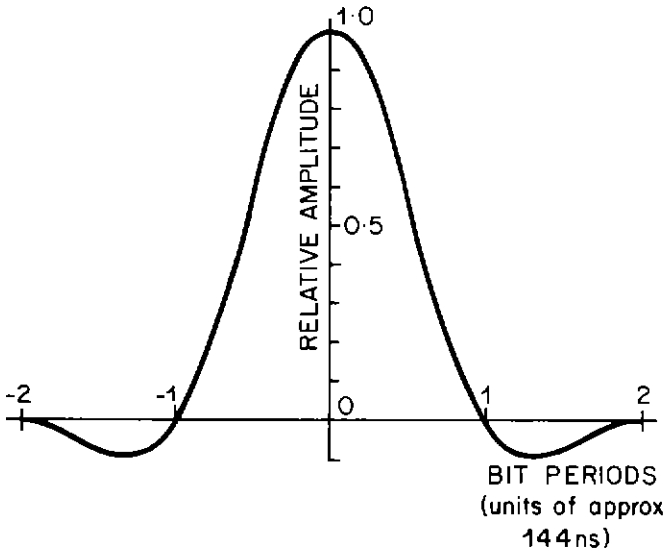



*Fig. A5 - An approximate one-bit data pulse*

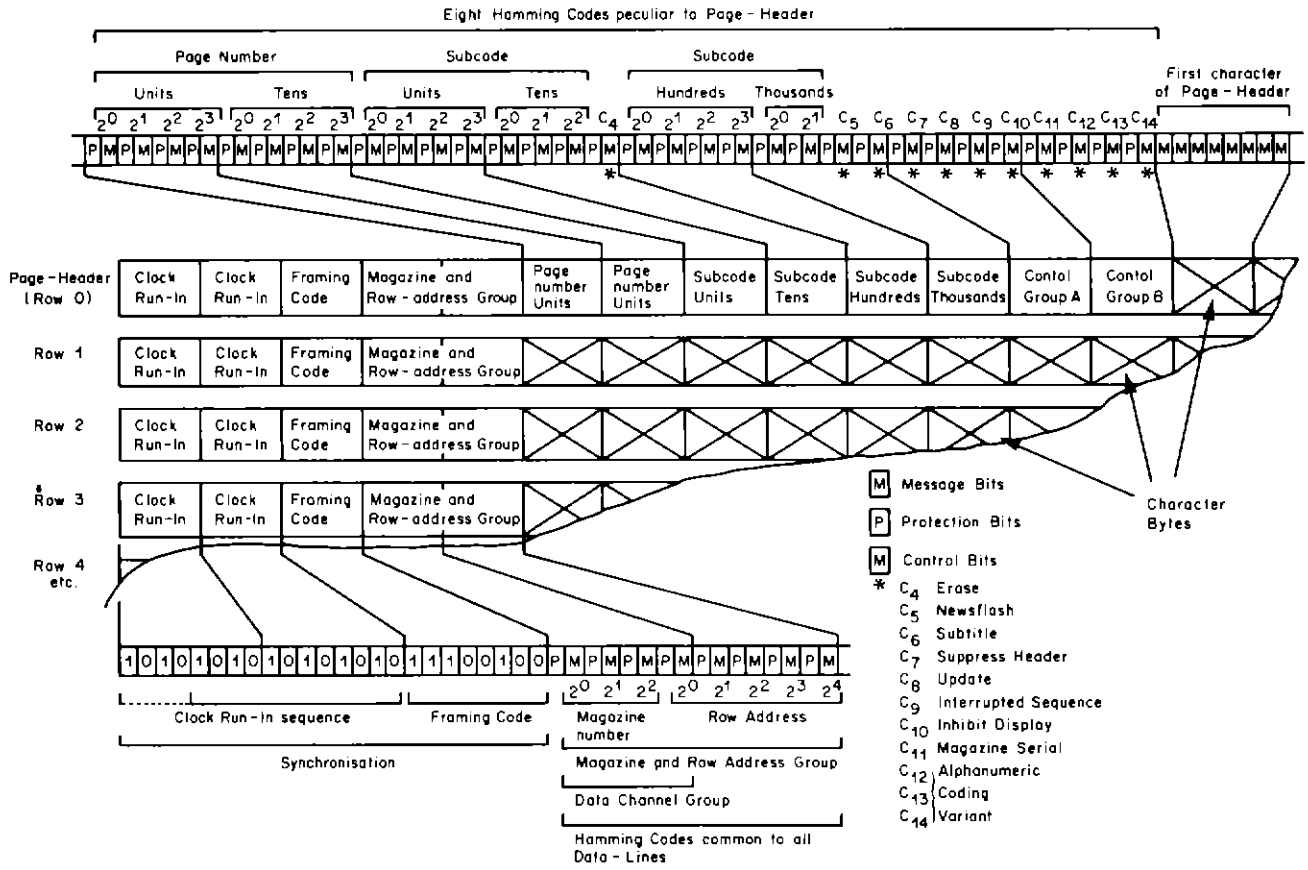



*Fig. A6 - Synchronisation and Hamming Codes at start of Page-Header and other Data-Lines*

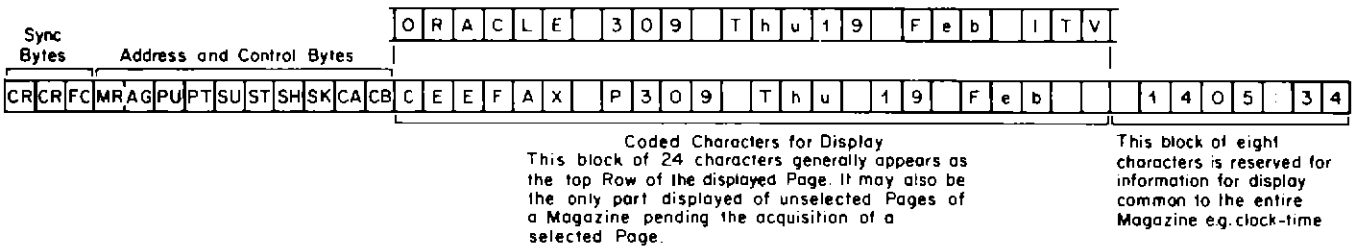



*Fig. A7a - Format of Data-Lines with Row Number 0 (Page-Headers)*

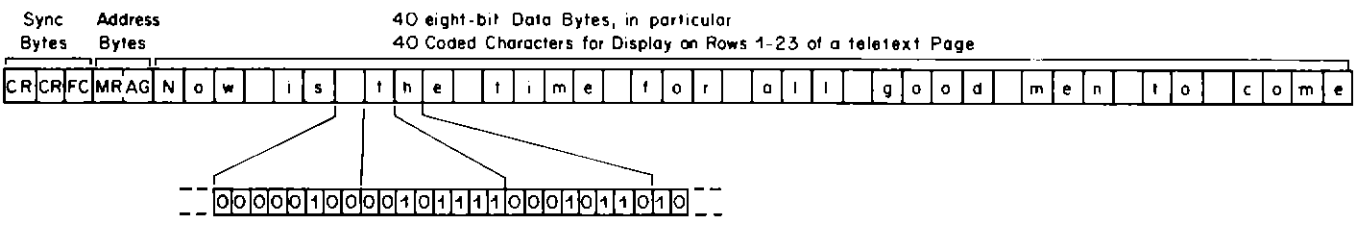



*Fig. A7b - Format of other Data-Lines*

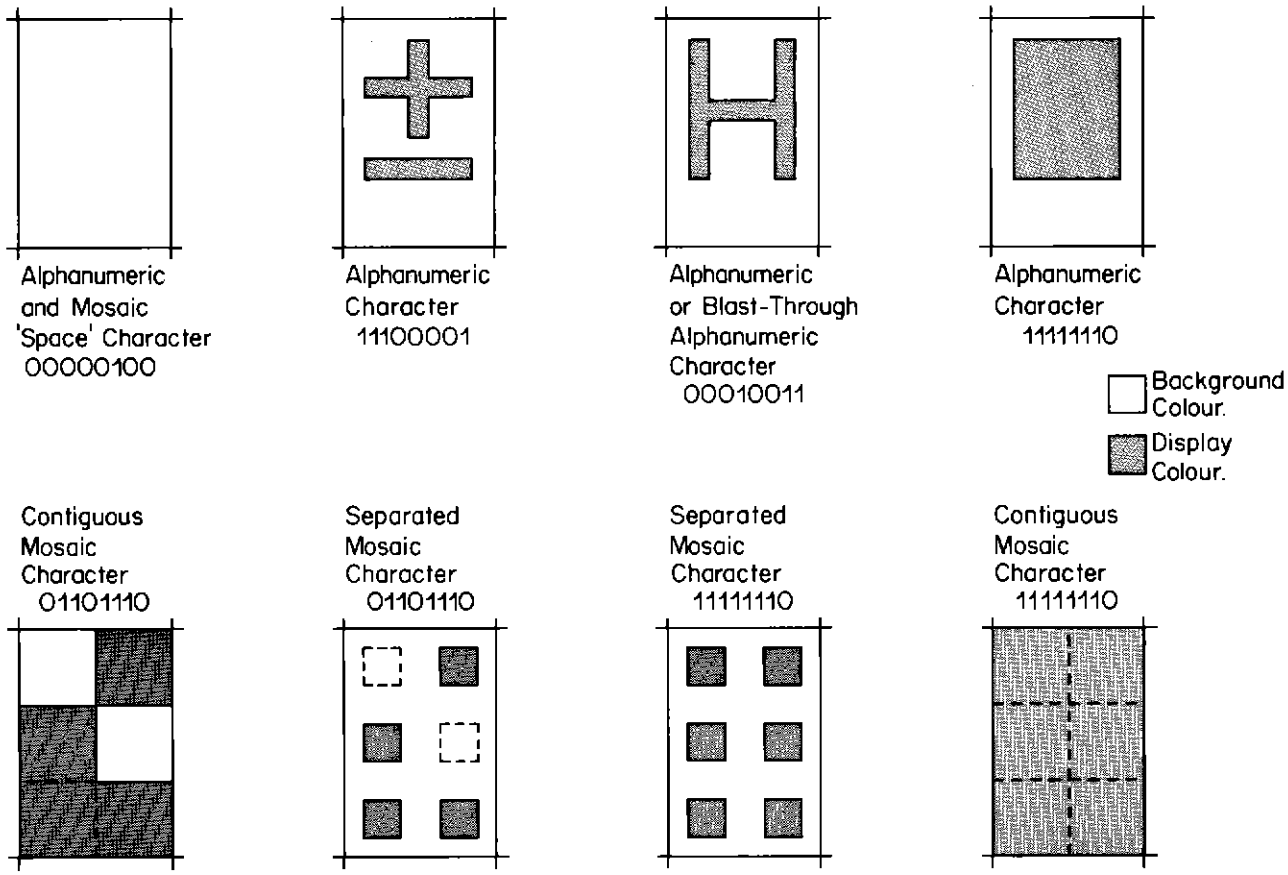



*Fig. A8 - Examples of Alphanumeric and Mosaic displays*

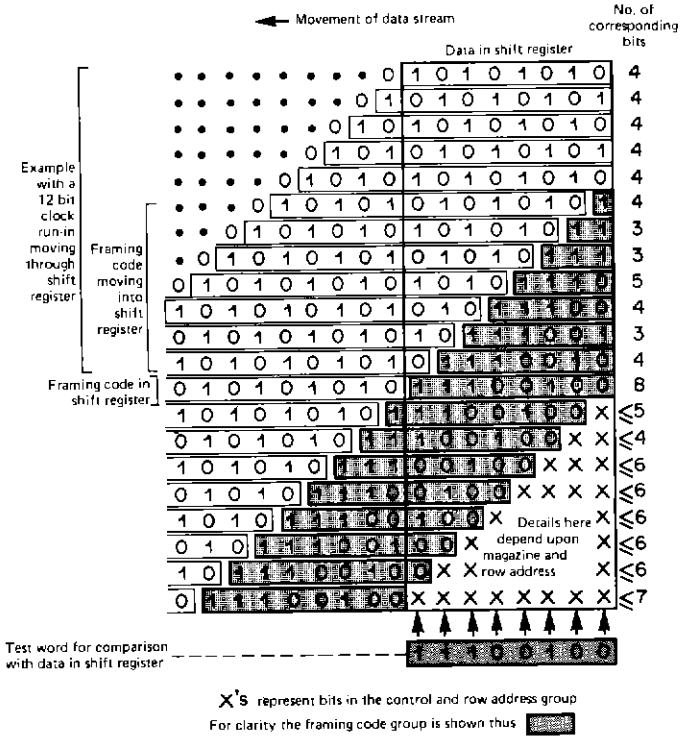



*Fig. A9 - Idealised operation of framing code*

*TABLE A1a*

*HAMMING CODE BYTES*

Protection Bits

MESSAGE BITS

| $b_8$ | $b_7$ | $b_6$ | $b_5$ | $b_4$ | $b_3$ | $b_2$ | $b_1$ |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |

*TABLE A1b*

*TESTS FOR ODD PARITY*

● Tested bits

| | $b_8$ | $b_7$ | $b_6$ | $b_5$ | $b_4$ | $b_3$ | $b_2$ | $b_1$ |
|---|---|---|---|---|---|---|---|---|
| A | ● | · | ● | · | · | · | ● | ● |
| B | ● | · | · | · | ● | ● | ● | · |
| C | · | · | ● | ● | ● | · | ● | · |
| D | ● | ● | ● | ● | ● | ● | ● | ● |

*TABLE A1c*

*DECODING ACTION*

| RESULTS OF PARITY TESTS | | INFERENCE | ACTION |
|---|---|---|---|
| A, B, C | D | | |
| All Correct | Correct | no errors | accept message bits |
| All Correct | Not Correct | error in $b_7$ | accept message bits |
| Not all Correct | Correct | multiple errors | reject message bits |
| Not all Correct | Not Correct | single error | refer to Table 1b to identify error. Correct error if in message bit. |

| DISPLAY MODE | SET AT | SET AFTER | COMPLEMENTARY DISPLAY MODE | SET AT | SET AFTER | SEE SECTION |
|---|---|---|---|---|---|---|
| ALPHANUMERIC | *Row Start* | *O0/1 O0/2 O0/3*<br>*O0/4 O0/5 O0/6 O0/7* | MOSAIC | – | *O1/1 O1/2 O1/3*<br>*O1/4 O1/5 O1/6 O1/7* | A.3.1.1. |
| CONTIGUOUS and PLAIN | *Row Start*<br>*O1/9* | – | SEPARATED and UNDERLINE | – | *O1/10* | A.3.1.1.<br>A.3.1.8. |
| DISPLAY COLOUR includes RED | *Row Start* | *O0/1 O0/3 O0/5 O0/7*<br>*O1/1 O1/3 O1/5 O1/7* | DISPLAY COLOUR excludes RED | – | *O0/2 O0/4 O0/6*<br>*O1/2 O1/4 O1/6* | A.3.1.2. |
| DISPLAY COLOUR includes GREEN | *Row Start* | *O0/2 O0/3 O0/6 O0/7*<br>*O1/2 O1/3 O1/6 O1/7* | DISPLAY COLOUR excludes GREEN | – | *O0/1 O0/4 O0/5*<br>*O1/1 O1/4 O1/5* | |
| DISPLAY COLOUR includes BLUE | *Row Start* | *O0/4 O0/5 O0/6 O0/7*<br>*O1/4 O1/5 O1/6 O1/7* | DISPLAY COLOUR excludes BLUE | – | *O0/1 O0/2 O0/3*<br>*O1/1 O1/2 O1/3* | |
| BLACK BACKGROUND | *Row Start*<br>*O1/12* | – | NEW BACKGROUND | *O1/13** | – | A.3.1.3. |
| REVEAL | *Row Start*<br>*User Control*** | *O0/1 O0/2 O0/3*<br>*O0/4 O0/5 O0/6 O0/7*<br>*O1/1 O1/2 O1/3*<br>*O1/4 O1/5 O1/6 O1/7* | CONCEAL | *O1/8* | – | A.3.1.4. |
| STEADY | *Row Start*<br>*O0/9* | – | FLASH | – | *O0/8* | A.3.1.4. |
| UNBOXED | *Row Start*<br>*O0/10**** | *O0/10**** | BOXED | *O0/11**** | *O0/11**** | A.3.1.5. |
| NORMAL HEIGHT | *Row Start*<br>*O0/12* | – | DOUBLE HEIGHT | – | *O0/13* | A.3.1.6. |
| RELEASE | *Row Start* | *O1/15* | HOLD | *O1/14* | – | A.3.1.7. |

* whenever this code occurs the Display Colour is adopted as the New Background colour,
** the Reveal mode may be maintained throughout a page by a user control,
*** two consecutive codes are transmitted, the mode changes between them.

*TABLE A2 - DISPLAY MODES AND CONTROL CHARACTERS*

| $b_8$* | $b_7$ $b_6$ $b_5$ → | $0_{0_0}$ | $0_{0_1}$ | $0_{1_0}$ | | $0_{1_1}$ | | $1_{0_0}$ | $1_{0_1}$ | $1_{1_0}$ | | $1_{1_1}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bits $b_4$ $b_3$ $b_2$ $b_1$ Col/Row | 00 | 01 | 02 | 02a | 03 | 03a | 04 | 05 | 06 | 06a | 07 | 07a |
| | 0 0 0 0 0 | NUL① | DLE① | | | 0 | | @ | P | — | | p | |
| | 0 0 0 1 1 | Alpha$^n$ Red | Mosaic Red | ! | | 1 | | A | Q | a | | q | |
| | 0 0 1 0 2 | Alpha$^n$ Green | Mosaic Green | " | | 2 | | B | R | b | | r | |
| | 0 0 1 1 3 | Alpha$^n$ Yellow | Mosaic Yellow | £ | | 3 | | C | S | c | | s | |
| | 0 1 0 0 4 | Alpha$^n$ Blue | Mosaic Blue | $ | | 4 | | D | T | d | | t | |
| | 0 1 0 1 5 | Alpha$^n$ Magenta | Mosaic Magenta | % | | 5 | | E | U | e | | u | |
| | 0 1 1 0 6 | Alpha$^n$ Cyan | Mosaic Cyan | & | | 6 | | F | V | f | | v | |
| | 0 1 1 1 7 | Alpha$^n$ White② | Mosaic White | ' | | 7 | | G | W | g | | w | |
| | 1 0 0 0 8 | Flash | Conceal Display | ( | | 8 | | H | X | h | | x | |
| | 1 0 0 1 9 | Steady② | Contiguous Mosaic, Stop Underline② | ) | | 9 | | I | Y | i | | y | |
| | 1 0 1 0 10 | End Box② | Separated Mosaic, Start Underline | * | | : | | J | Z | j | | z | |
| | 1 0 1 1 11 | Start Box | ESC① | + | | ; | | K | ← | k | | ¼ | |
| | 1 1 0 0 12 | Normal Height② | Black Background② | , | | < | | L | ½ | l | | ‖ | |
| | 1 1 0 1 13 | Double Height | New Background | − | | = | | M | → | m | | ¾ | |
| | 1 1 1 0 14 | SO① | Hold Mosaic | . | | > | | N | ↑ | n | | ÷ | |
| | 1 1 1 1 15 | SI① | Release Mosaic②③ | / | | ? | | O | # | o | | | |

Variant code 000 (UK Teletext). See Table 4 for other variants.

* $b_8$ is set to give an odd number of 1's in the eight bit character code.

① These control characters are reserved for future use.

② These control characters are presumed before each row begins.

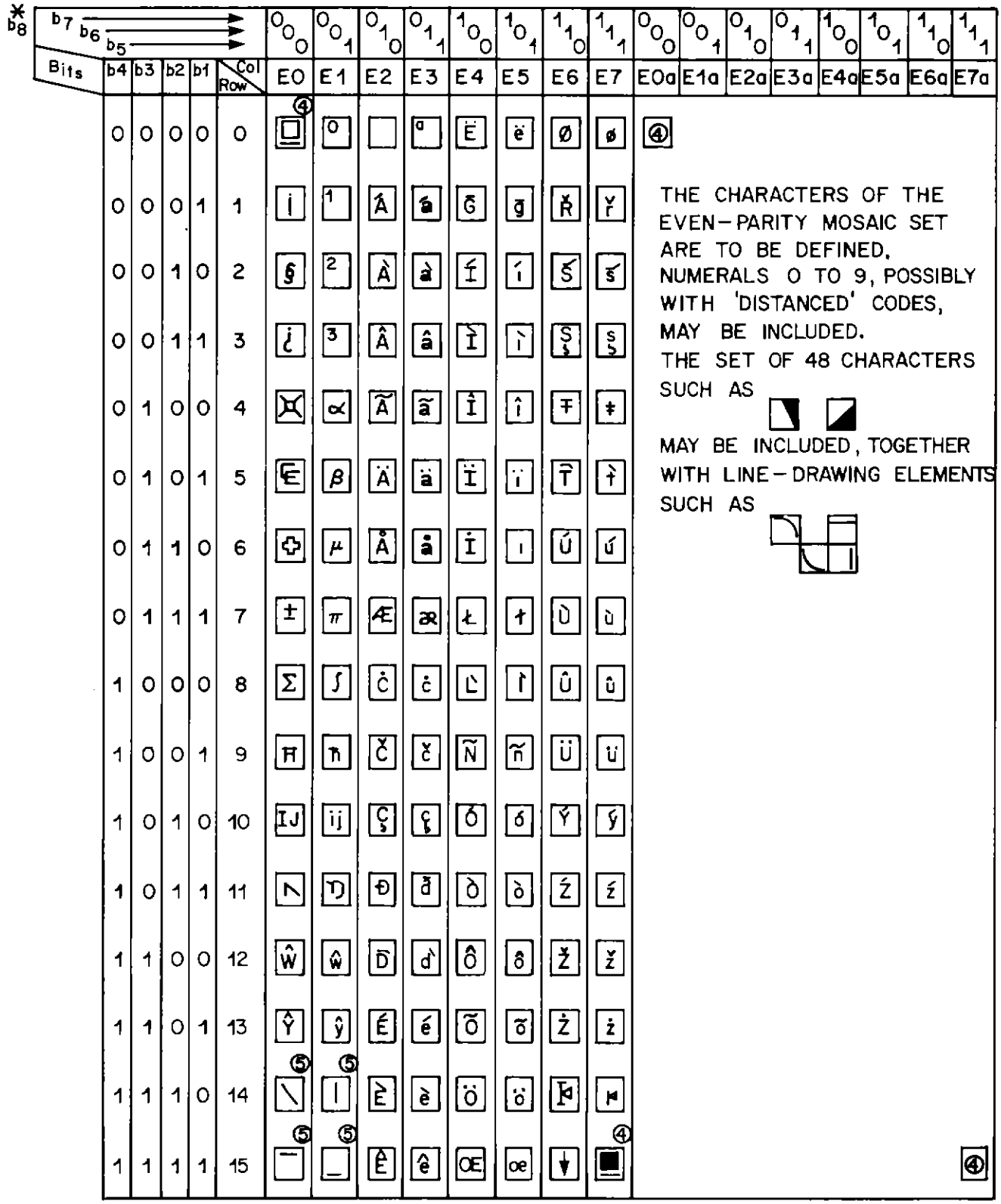
③ Also 'Restore Format'

Codes may be referred to by their column and row e.g. 02/5 refers to %.

Character rectangle

Black represents display colour
White represents background

*TABLE A3a - Teletext character codes — odd parity*




Variant code 000 (UK Teletext). See Table 4 for other variants.

* $b_8$ is set to give an odd number of 1's in the eight bit character code.

④ These characters have restricted use.

⑤ If additional characters are required it is recommended that they be substituted in these positions.

*TABLE A3b - Teletext character codes — even parity*

| VARIANT | 0 GB | 1 D | 2 S/SF |
|---|---|---|---|
| $C_{12}$ $C_{13}$ $C_{14}$ | 0 0 0 | 0 0 1 | 0 1 0 |
| Character Codes | | | |
| 02/3 | £ | # | # |
| 02/4 | $ | $ | ¤ |
| 04/0 | @ | § | É |
| 05/11 | ← | Ä | Ä |
| 05/12 | ½ | Ö | Ö |
| 05/13 | → | Ü | Å |
| 05/14 | ↑ | ^ | Ü |
| 05/15 | # | _ | _ |
| 06/0 | _ | ° | é |
| 07/11 | ¼ | ä | ä |
| 07/12 | ‖ | ö | ö |
| 07/13 | ¾ | ü | å |
| 07/14 | ÷ | ß | ü |
| 07/15 | ■ | DEL | ■ |
| E0/2 | § | @ | § |
| E0/4 | ¤ | ¤ | $ |
| E1/0 | ° | — | ° |
| E1/5 | ß | ÷ | ß |
| E1/15 | — | £ | £ |
| E2/0 | | ■ | |
| E2/5 | Ä | ← | ← |
| E2/6 | Å | Å | → |
| E2/13 | É | É | @ |
| E3/5 | | ¼ | ¼ |
| E3/6 | ä | ä | ¾ |
| E3/13 | é | é | — |
| E4/14 | Ö | ½ | ½ |
| E5/14 | ö | ‖ | ‖ |
| E6/9 | Ü | → | ↑ |
| E7/9 | ü | ¾ | ÷ |

*TABLE A4a*

Lists the 14 character codes of the basic 96 character odd-parity set which do not share a common meaning in the teletext systems now in use in the UK, Germany and Sweden.

An allocation of the control bits $C_{12}$, $C_{13}$, $C_{14}$ in the Page Header to signify each variant is given.

A decoder responding to these control bits could select the correct interpretation of these codes automatically.

*TABLE A4b*

Lists the variations necessary in the accompanying even-parity set to ensure, with the minimum of transcoding, that the overall repertoire of each variant is the same, with each character having a single code within a variant.

NOTES

Table A4 can be extended to accommodate other variants where all the characters of the basic set exist in Tables A3a or A3b.

Table A3 can be based on any of these variants since all the characters not listed in Table A4 are coded in the same way in all the variants.

## ANNEX B

## THE FUNCTION OF ROWS 24 TO 29 IN A PAGE

Data-Lines carrying Row Addresses in the inclusive range 24 to 29 relate to the accompanying teletext page with the same magazine number. None of them is necessarily used but its function when used is described below.

**Rows 24 and 25** are used for Data-Lines carrying information relating to the Page, or Pseudo-Page, each address being used only once in a given page. In particular, a block of 1024 bytes can be transmitted as a pseudo-page by using the middle 24 bytes of the Page-Header and all 40 bytes of each of the Rows 1 to 25. Although the size of a teletext page store need only be some 960 bytes, a store capable of receiving and processing a complete Pseudo-Page must be capable of holding at least 1032 eight-bit bytes, with addresses related to the Row Addresses and position in the Data-Line, together with associated control and labelling information. For the purpose of checking the content of this extended page store Rows 24 and 25 are presumed to contain the odd-parity NULL characters (O0/0) in the absence of other information following a Page erasure.

**Rows 26 and 27** are reserved for future use as page-associated data channels. A Data-Line carrying one of these addresses may be used more than once in each transmission of a page, possibly carrying different information each time it is used. There is no implied relationship between the data sent on these Rows and they may be used to manipulate or modify the contents of a Page Store or the method of Page display.

**Rows 28 and 29** are used as page-associated Data-Lines. The content of each of these is fixed for a given transmission of a Page. Row 28 is reserved for future use and Row 29 is used as the Page Service Row.

### Page Service Row

Row 29 of a Page, when transmitted, contains 40 Hamming-coded bytes according to Table A1. The first four bytes comprise a 16-bit cyclic redundancy check on Rows 1 to 25 inclusive, together with the middle 24 bytes of Row 0 of the page. For this purpose rows never transmitted since the page was last cleared by use of the erase bit are assumed to contain the NULL character (O0/0). If Rows 26 or 27 are used to modify the content of the page this check must be defined in such a way as to include a check of these modifications. This check is used to indicate that a particular page has been correctly and completely received. In automatic page selection and recording systems this check allows each page to be tested before use.

The remaining 36 bytes of Row 29 contain the Magazine number, Page number and Sub-code of up to six Pages related to the current Page. These, which can be called 'Next 0', 'Next 1' .... 'Next 5', can be used in a multipage decoder to preselect the pages which may be chosen by the viewer as a result of reading the current page. The viewer may be given a choice 'for . . . key next-2' etc. in a decision tree structure. Next 0 would be used to access the start of a sequence of pages and certain codes (such as Page FF, Subcode 3F7F) could be reserved to terminate a sequence. The six bytes containing each 'next' page would be formatted in the same way as the six bytes of page address in the page header, with control bits $C_4$, $C_5$, $C_6$ replaced by a 'change-magazine' code normally set at 000.

Note that the page service row of the initial page (itself signalled by the service data line) allows a total of seven pages to be preselected, under editorial control, before the viewer has even selected teletext.

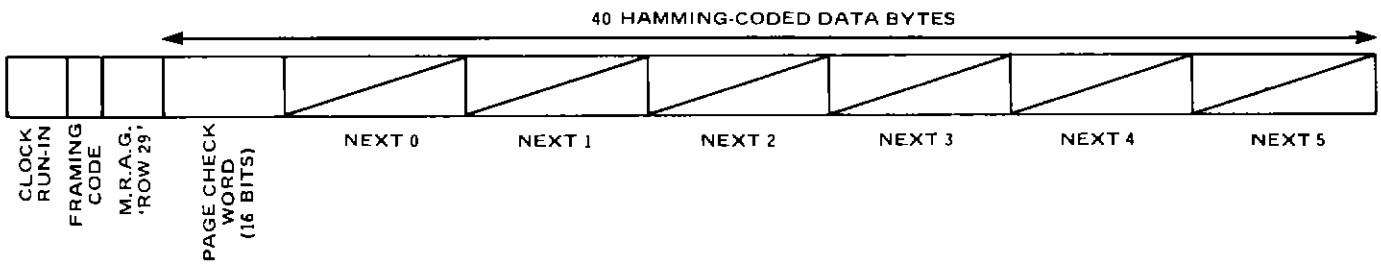



*Fig. B1 - Structure of Page Service Row*

## ANNEX C

### (1) INDEPENDENT DATA-LINES

Data-Lines with the message bits 1111 in the second bytes of the Magazine and Row Address Group (MRAG) are independent of the page and magazine structure of teletext. However and whenever such Data-Lines are used they do not affect the normal operation of a teletext decoder.

The four message bits of the first MRAG group on Independent Data-Lines are known as the Data Channel Group (see Fig. A6). This identifies the Data-Line as belonging to one of 15 Auxiliary Data Channels numbered according to the binary code (least significant bit first). The Data Channel Address code 0000 is reserved for the Television Service Data-Line (see below).

The Independent Data-Lines may be interleaved in any way with each other and with Data-Lines of Teletext Magazines. Where use of the Auxiliary Data Channels is envisaged a teletext decoder should provide for the output of the 40-byte groups of each such Data-Line together with its four-bit data Channel Address.

Auxiliary Data Channels may be used for any data transmission function. The effective number of channels may be increased by defining an additional address structure within the 40-byte groups.

### (2) TELEVISION SERVICE DATA-LINE

The Data-Line carrying the message bits 00001111 in the Magazine and Row Address Group is the Television Service Data-Line. This carries information, generally coded for machine use rather than for direct display as text, in the following categories:

- relating to the accompanying television programme
  - a unique network identification code
  - labelling of current and forthcoming programme
  - a short data field, coded in teletext codes from the 'common core' of the odd-parity set, intended for display on the screen.
- relating the teletext service to the television service
  - the Magazine, Page and Subcode number of the 'initial' page of the teletext service
- unrelated to television and teletext
  - date, day and time, expressed in UTC terms with 'local offset'.

The Television Service Data-Line is generally repeated every second, and it is preferably sent only immediately prior to a UTC seconds change. A possible format is indicated below.

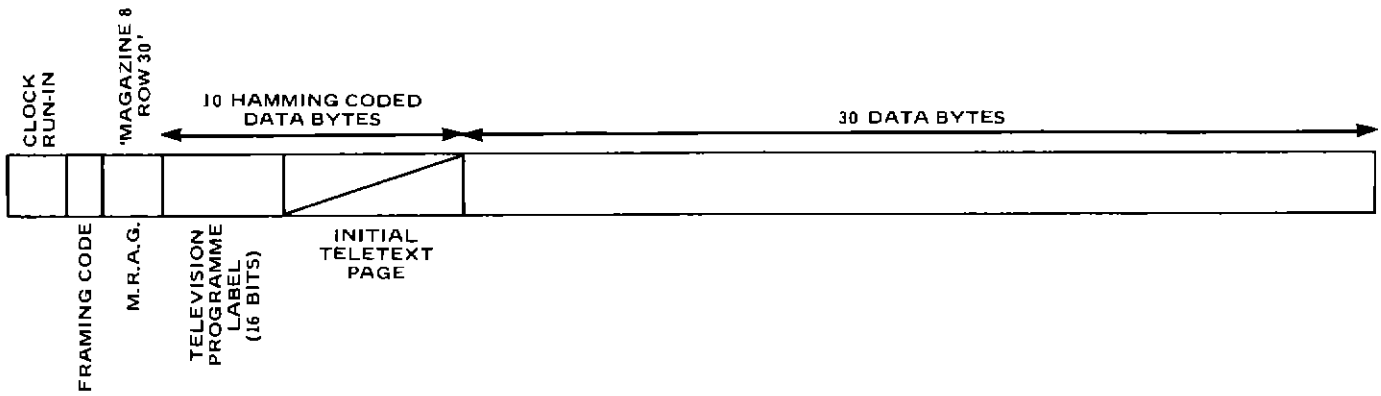



*Fig. C1 - Structure of Television Service Data-Line*

## ANNEX D

## HIGH DEFINITION TELETEXT

Within the concept of data pages indicated, methods for signalling pages containing more than the rows of text and elementary mosaic graphics of basic teletext can be defined. Such methods are capable of signalling any static picture which can be displayed on a conventional 625-line colour television receiver, or a sequence of such pictures.

The methods can be based on a grid of picture elements corresponding to 576 active lines and 12 elements per microsecond of active line (i.e. about 624 elements per active line). For most purposes the working area can be limited to that defined by the central 512 elements of the vertical and horizontal ranges. For many purposes there can be a restricted but redefinable range of working colours in a page.

The methods presume the existence of a frame store with several bits of storage per picture element, the store being written into under control of the input data. The signalling methods can allow regular repetitive writing operations, possibly with systematic variations of parameters, to be coded efficiently. The words stored in the frame store would not, in general, be directly for display but would control an output interpreter whose function can be varied by the input signal codes and by the stored codes themselves as they are read in sequence.

The system can provide for the display of pages partly in the basic teletext format and partly in the high-definition teletext mode, in which case the unused part of the frame store may be assigned to other functions, including the storage of alternative high-definition sub-pictures.

In its most general, and least efficient, mode such a system is capable of transmitting, storing and displaying still colour television pictures of arbitrary content without the imperfections of the conventional colour coding processes and with a horizontal resolution limited only by the 12 MHz sample rate.

A less completely-equipped decoder would be able to receive and display teletext pages incorporating small pictures, logos, ideograms and special symbols outside the currently defined teletext repertoire.

The definition of a hierarchy of coding systems to allow pictures of intermediate quality (such a line drawings and geometrically defined areas filled by uniform colours) is a subject of current study. The enhanced teletext system described in this document can be extended to accommodate such systems in the future.



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